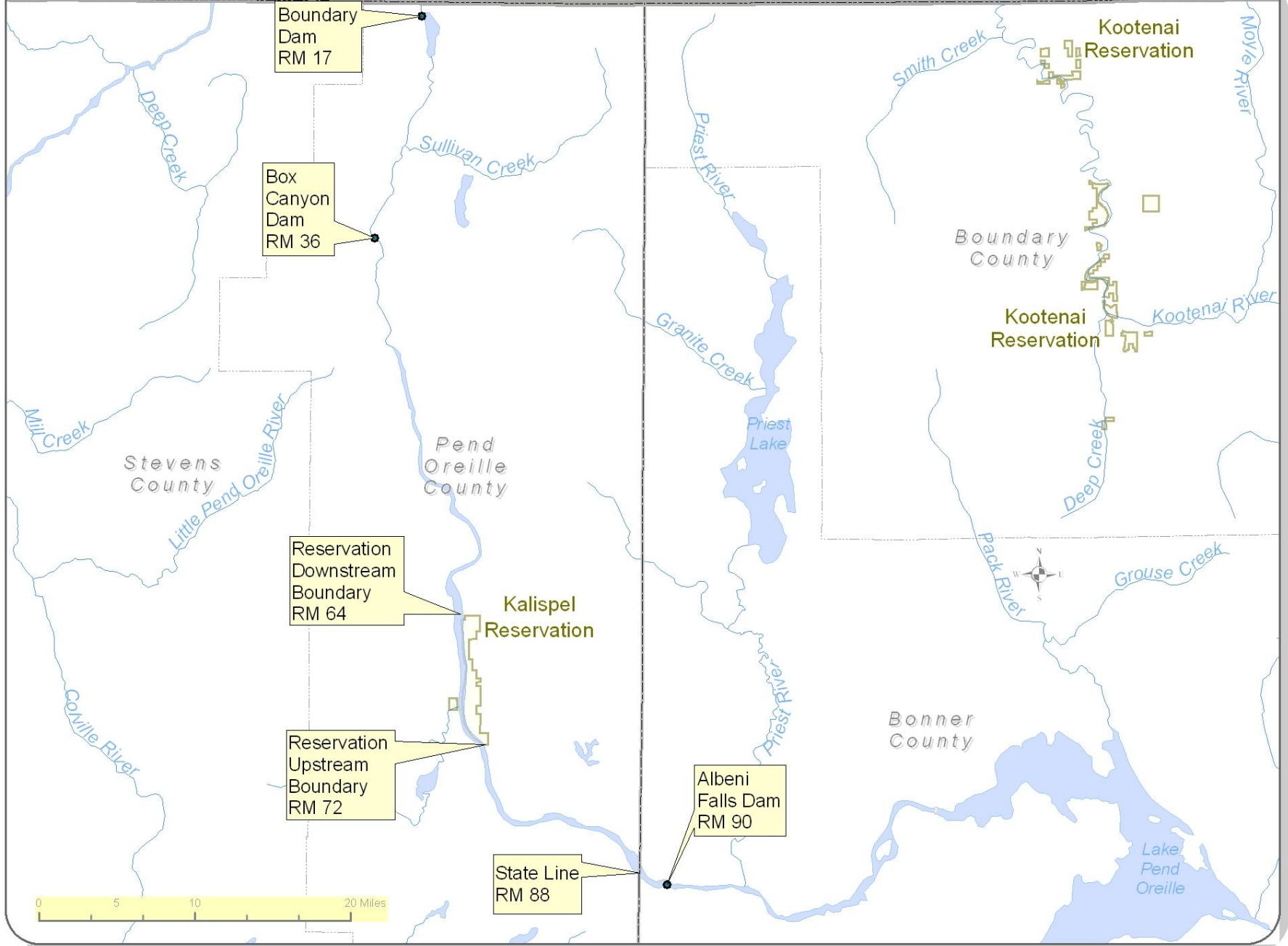


Pend Oreille River Temperature TMDL

Introduction

- History of the TMDL
- Basic Introduction to Daily Comparison and Cumulative Frequency Analysis (CFA)
- Why the TMDL should be approved
- Specific Issues
 - Exceedences Using the Different Methods
 - Daily Maximum Criteria
 - State Line Heat Loading
 - Tribal WQS and Sovereignty
 - Reasons Ecology chose CFA
 - Data Pooling Period
 - Use of CFA with Interdependent Data

British Columbia



TMDL History

- **2004 - 2007** EPA, Kalispel Tribe, States of Washington and Idaho collaborate on TMDL
- **May 2004** – MOA between States, Tribe and EPA signed
- **July 2007** Draft Interjurisdictional TMDL shared with stakeholders
- **July 2007 – December 2009**
 - States address stakeholder comments on TMDL
 - EPA - Ecology discourse on WQS interpretation
 - Washington moves forward with TMDL using CFA
- **January 2009 - August 2010** - Two staff meetings between EPA & Kalispel Tribe
- **Fall 2010** – Draft Washington TMDL out for public comment
- **January 2011** Third staff meeting between EPA and Kalispel Tribe

TMDL History

- **Spring 2011** EPA letter to Kalispel Tribe offering consultation; Tribe accepts
- **April 2011** Ecology submits TMDL to EPA; Dam operators request dispute resolution & file lawsuits
- **Summer 2011** Consultation between RA & Tribal Chairman in Spokane, followed by RA letter
- **August 2011** Dispute Resolution Process completed;
- **November 2011** Ecology submits final TMDL; Fourth Meeting between EPA & Tribal staff
- **February 2012** Phone conversation and follow up letter from Office of Water Director, Mike Bussell to Deane Osterman at Kalispel Tribe Natural Resources Department
- **Spring Summer 2012** – 2 FOIAs and FOIA appeal by Tribe
- **July 2012** – HQ meeting with Tribe

2004 MOA

- The MOA was only partially completed (no interjurisdictional TMDL) due to loss of funding in Idaho and this dispute between Ecology and the Tribe
- The MOA was not a binding agreement, and all parties understood this
- The collaboration that occurred under the MOA was invaluable to all parties – building models that are based on consistent assumptions and data, forming a strong technical basis for the TMDL

EPA Support for Tribe

- Provided the Tribe with \$105,000 in grant and contract funding for work related to the TMDL
- Negotiated for over a year with Ecology to reverse a Pend Oreille River standards interpretation that was opposed by the Tribe
- Successfully intervened on proposed changes to TMDL from dispute resolution process in response to Tribe's comments
- Multiple meetings with Tribe attempting to resolve their issues with TMDL

Tribal Interest

- Tribe is satisfied with allocations at Boundary and Box Canyon Dams
- Primary Issue: Albeni Falls Dam and determination of heat loading at state line
- Interest in using the TMDL to leverage discussions with the Corps re: Albeni Falls Dam

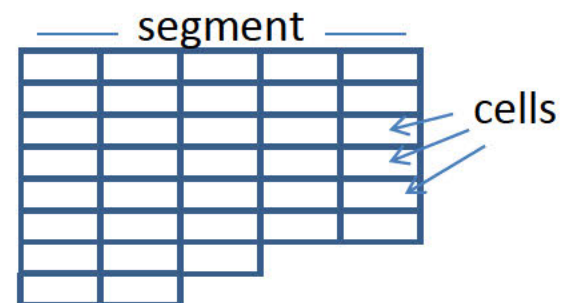
Technical primer:
Daily Comparison and CFA Methods

Washington Temperature Criteria

- Temperature shall not exceed a 1-day maximum (1-DMax) of 20°C due to human activities.
- When natural conditions exceed a 1-DMax of 20°C, no temperature increase will be allowed which will raise the receiving water temperature by greater than 0.3°C

The model

- The TMDL divides the river into segments along its length
 - Each segment is a collection of model cells (vertical and horizontal)
- Data generated for each segment on half hour intervals for 2004 and 2005
 - Max daily value from all cells in segment is selected as segment value, consistent with max daily criteria
- Two model runs
 - a Natural Conditions simulation without the dams
 - an Existing Conditions simulation
- Each simulation has data for every segment and every half hour over the two years modeled



Daily Comparison Method

- Compares the maximum daily temperatures from the Existing Conditions simulation to data from the same time and location in the Natural Conditions simulation
 - the difference, minus the 0.3 human use allowance, is the magnitude of impairment
- Daily differences can then be aggregated, statistics calculated, etc.
- Tribe is advocating daily comparison with no aggregation and no statistics – i.e., maximum values, “excursions”

Date Natural Existing Diff

06/30/05	19.41	18.58	-0.83
07/01/05	19.98	19.07	-0.91
07/02/05	20.43	19.27	-1.17
07/03/05	20.51	19.52	-0.99
07/04/05	20.19	19.90	-0.29
07/05/05	20.16	20.05	-0.10
07/06/05	20.43	19.75	-0.69
07/07/05	20.76	19.87	-0.89
07/08/05	21.11	20.03	-1.09
07/09/05	20.74	20.13	-0.60
07/10/05	20.68	20.13	-0.55
07/11/05	20.20	20.13	-0.07
07/12/05	20.39	20.55	0.16
07/13/05	20.69	20.58	-0.11
07/14/05	21.19	20.52	-0.67
07/15/05	21.39	20.53	-0.86
07/16/05	21.31	20.57	-0.74
07/17/05	22.25	20.88	-1.38
07/18/05	22.90	21.37	-1.52
07/19/05	22.59	21.78	-0.81
07/20/05	22.96	21.80	-1.16
07/21/05	23.52	22.08	-1.45
07/22/05	22.44	21.95	-0.49
07/23/05	23.28	21.83	-1.45
07/24/05	23.71	21.85	-1.86
07/25/05	23.43	21.97	-1.47
07/26/05	23.46	22.26	-1.20
07/27/05	23.64	22.52	-1.12
07/28/05	23.62	22.69	-0.93
07/29/05	23.60	22.72	-0.88

Daily comparison

30-60 avg

1-2 Week avg

7 day rolling avg

Point Data
90%, Max

Disadvantages of Single Value Approach

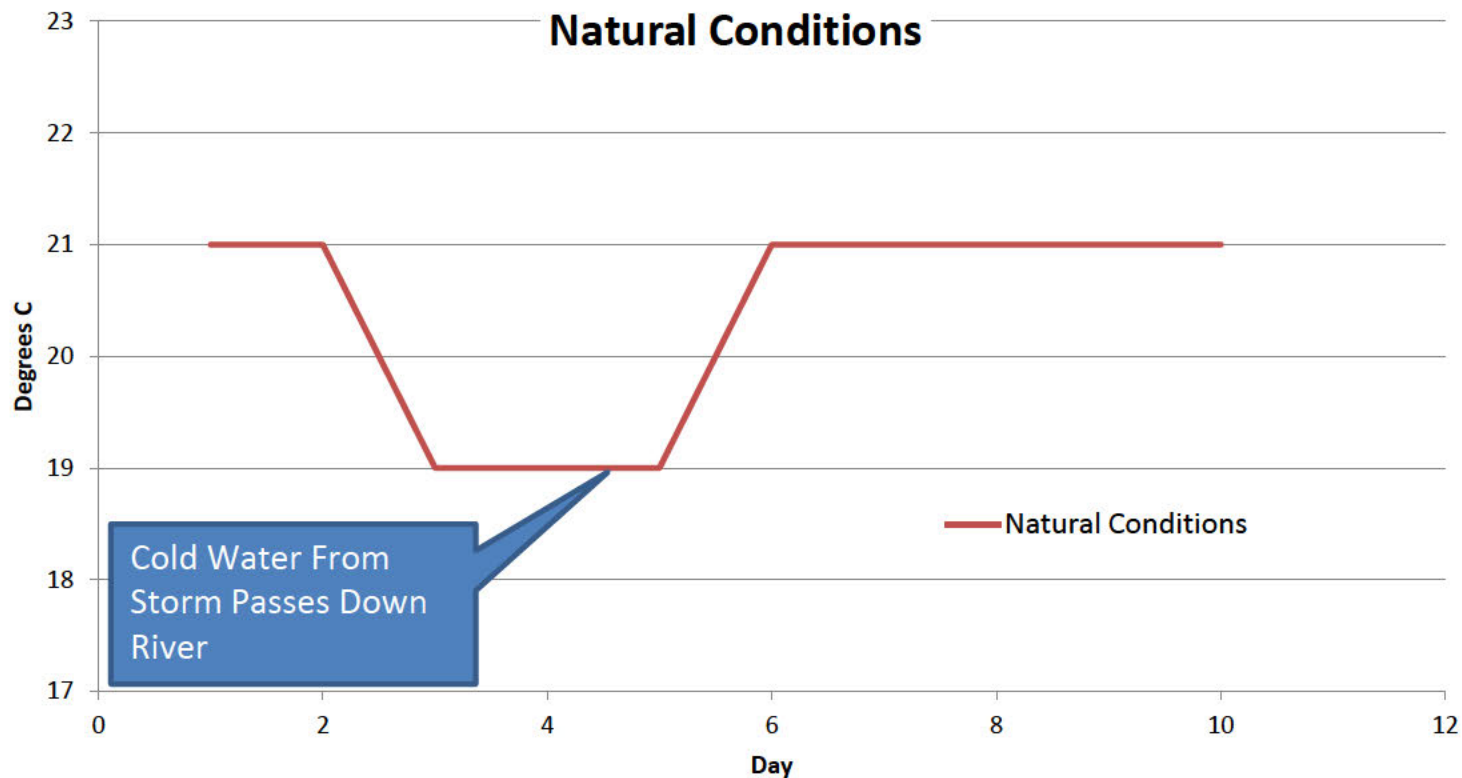
- Susceptible to bias due to short-term time lags
- Relies on model predictions at a single time and cell location.
 - Reasonable concern about uncertainty inherent in complex models
 - Science issue, not just legal/policy
- Focus on single day “violations” rather than loading capacity and allocations
 - TMDLs commonly aggregate data to set allocations (weekly/monthly/seasonal)
- No TMDLs in R10 have used single day max value from 2 dimensional models to set allocations

Time Lag

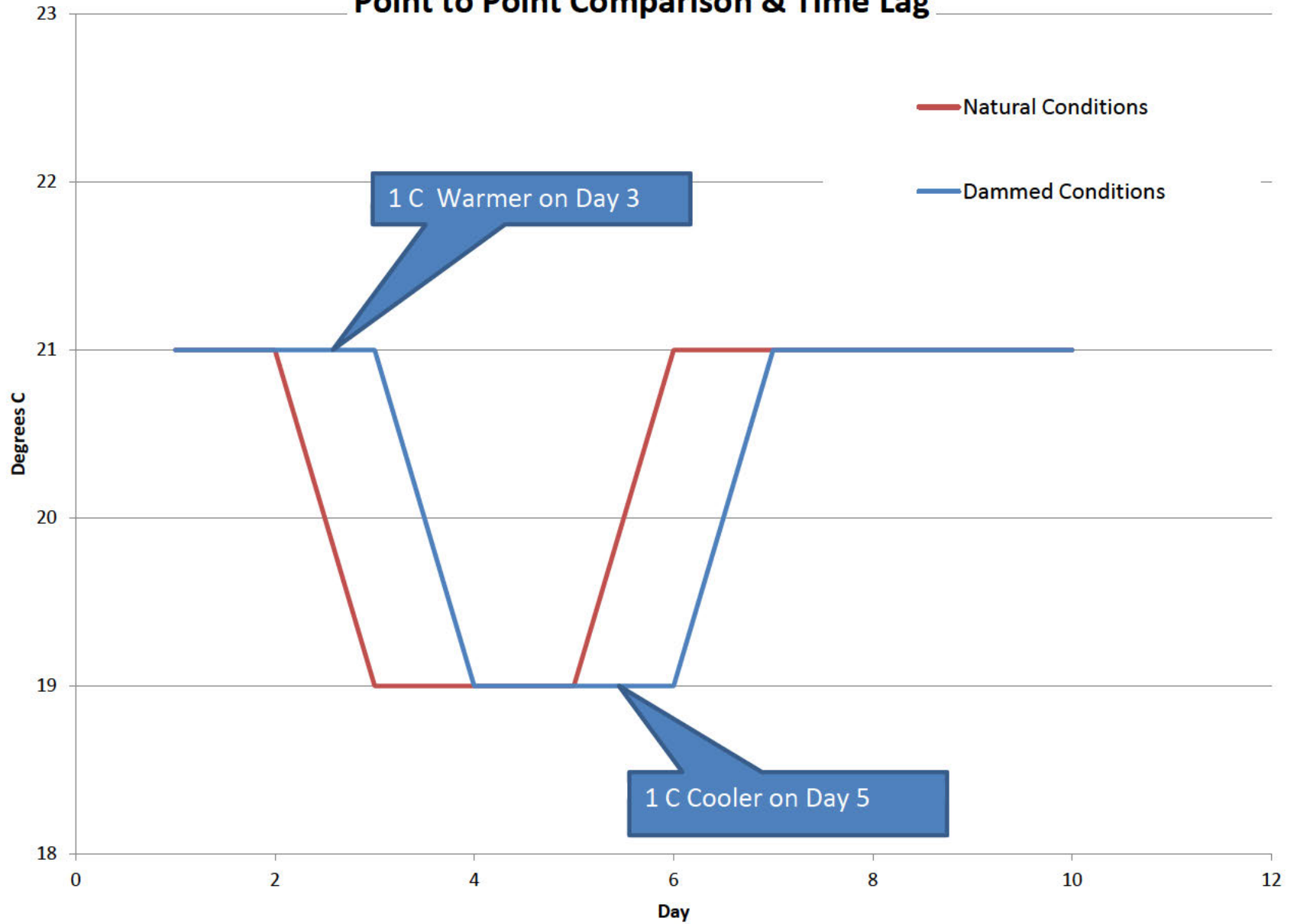
- Model simulates continuous response of river to weather conditions
- Dams slow the travel time of water in a river
- Cold weather front causes temperature drop.
- Cold “pulse” in river passes a model segment later due to dams.
- Daily Comparison “snapshot” captures the timing change as an impact.

Time Lag

- Conceptual diagram – fixed location
- Pulse due to storm onsite and cessation



Point to Point Comparison & Time Lag



Cumulative Frequency Analysis

- CFA is a statistical analysis of two data sets
- Data distributions are compared at each rank percentile value (frequency of occurrence in the data pool)
- One cannot do a cumulative frequency analysis without first aggregating (pooling) the data

Rank Natural Existing Diff

Lowest
temp

1	18.58	19.41	0.83
2	19.07	19.98	0.91
3	19.27	20.16	0.89
4	19.52	20.19	0.67
5	19.75	20.37	0.62
6	19.87	20.39	0.52
7	19.87	20.43	0.56
8	19.9	20.43	0.53
9	20.03	20.51	0.48
10	20.05	20.55	0.5
11	20.12	20.60	0.56
12	20.13	20.60	0.57
13	20.52	20.76	0.24
14	20.53	21.11	0.58
15	20.55	21.19	0.64
16	20.57	21.31	0.74
17	20.58	21.39	0.81
18	20.88	22.25	1.37
19	21.37	22.44	1.07
20	21.78	22.59	0.81
21	21.8	22.9	1.1
22	21.83	22.96	1.13
23	21.85	23.28	1.43
24	21.95	23.43	1.48
25	21.97	23.46	1.49
26	22.08	23.52	1.44
27	22.26	23.6	1.34
28	22.52	23.62	1.1
29	22.69	23.64	0.95
30	22.71	23.71	1
31	22.72	23.83	1.11
32	22.74	24.09	1.35
33	22.82	24.2	1.38

CFA ANALYSIS

Challenge in applying CFA:

- Selection of pooling period

WA approach: Drawn directly from
standard language

“When natural conditions exceed
criterion...”



TMDL uses maximum
difference for all ranked pairs

Highest
temp

CFA in TMDL

- The daily maximum data points in the existing conditions simulation that exceed each criteria were pooled (about 62 days)
 - Consistent with 2 part language in standard
- The corresponding data points (same location, same time) in the natural conditions simulation were also pooled
- These pools of data were then plotted by cumulative frequency of occurrence in the data set

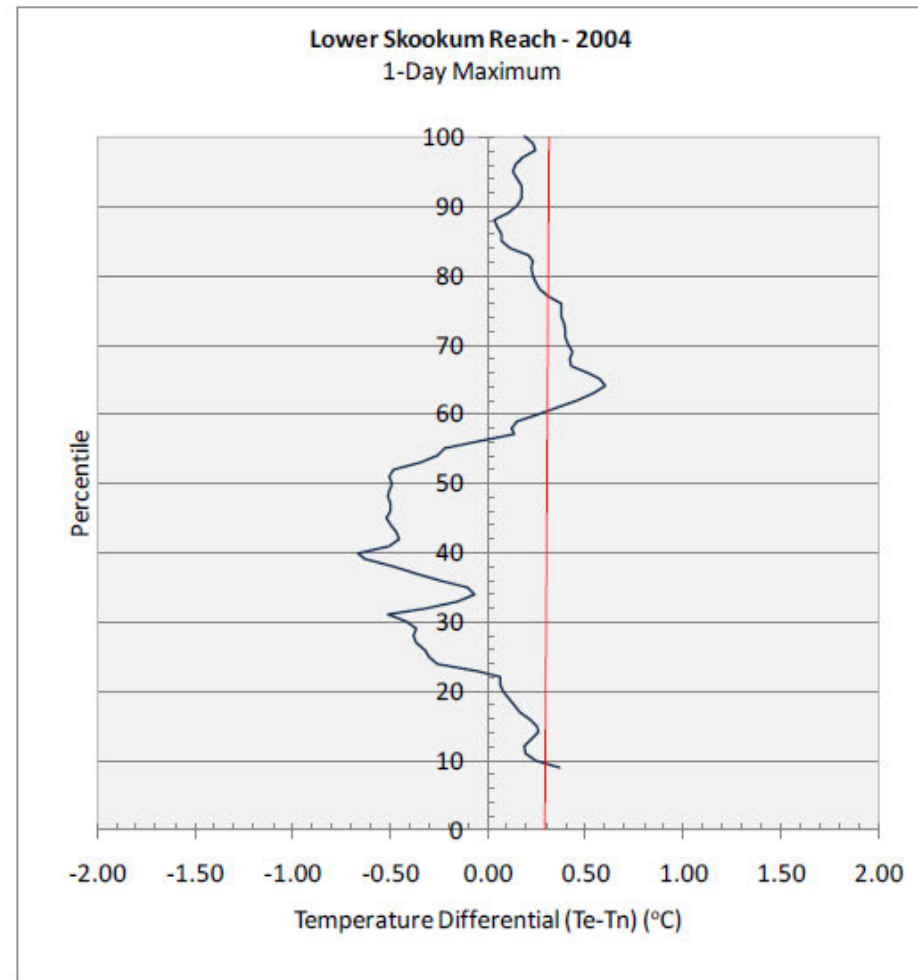
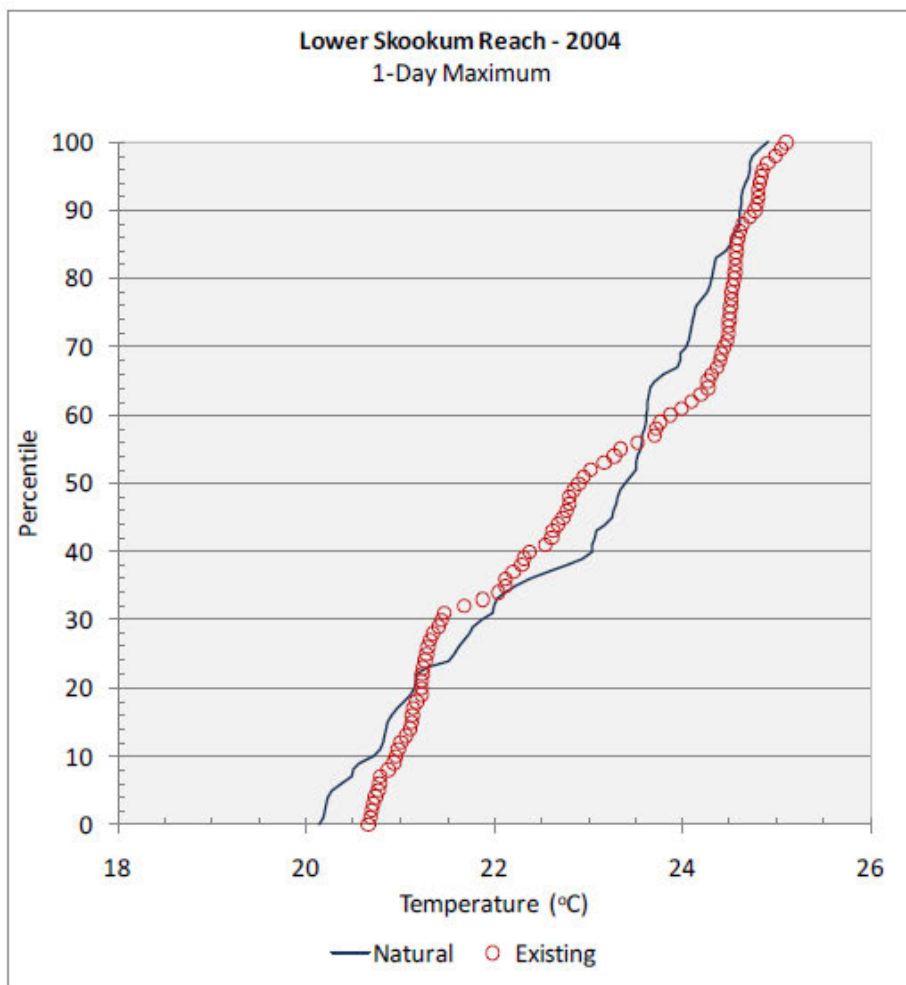


Figure 22. Segment 115 cumulative frequency distribution of daily maximum temperatures along with the associated temperature differential. Analysis includes the natural and existing conditions observed at lower Skookum reach (segment 115) in 2004.

Washington's Temperature Criteria provides no technical guidance

- Temperature shall not exceed a 1-day maximum (1-DMax) of 20°C due to human activities.
- When natural conditions exceed a 1-DMax of 20°C, no temperature increase will be allowed which will raise the receiving water temperature by greater than 0.3°C
- WA chose pooling period consistent with underlined clause above
- Period is July-August (62 days, not 93 days as tribe asserts)

Kalispel Standard – similar level of detail as WA standard

- Temperature shall not exceed 18°C as a moving 7-day average of the daily maximum temperatures with no single daily maximum temperature greater than 20.5°C.
- When natural background conditions prevent the attainment of the numeric temperature criteria, human-caused conditions and activities considered cumulatively can increase temperature levels by only an additional 0.3°C.
- WA pooling period consistent with underlined clause above.

Why the TMDL should be approved

II. Reasonable to aggregate model predictions

- Statistical analysis is common and useful
 - Requires pooling of data
 - Helps avoid regulating based on extreme or highly unusual conditions
- Common response to model uncertainty/error
- Necessary to develop reasonable TMDL

Use of CFA in TMDLs

An Incomplete List

- Willamette River Temperature TMDL, OR, 2006
- Florida Mercury TMDL, 2012
- Commonly used in bacteria TMDLs in many states including, CT, HI, ND, DE, NC, NJ, OR, AZ, TN, TX
- Stockton Deep Water Shipping Canal Dissolved Oxygen TMDL, CA, 2005
- Muddy Creek and the Yadkin River Turbidity TMDL, NC, 2011
- Upper Clinch Watershed pH TMDL, TN, 2009
- Potomac Estuary PCB TMDL, DC, 2007
- Lake Elsinore and Canyon Lake Nutrient TMDL, CA, 2005
- Buckhannon River pH and metals TMDL, WV, 2010
- Indian Creek, Southampton Creek Paxton Creek and Goose Creek and Sawmill Run Watersheds total phosphorus and sediment TMDLs, PA (Issued by EPA) 2008
- Ridenour Lake Metals TMDL, WV,

Weather Data

- Evidence from all climate stations used in model shows 90% cloud cover, high precipitation and unusually cool conditions between August 22 and 29, 2004, when half of the exceedences occurred
- Deer Park, Newport, Felts Field, and Tacoma Creek stations show storm conditions on June 30, 2004
- Local stations show some rain fall on June 24, 2004

Albeni Falls Dam

- Kalispel Tribe makes two assertions
 - (1) State line is impaired based on the “correct” (Daily Comparison) analytical method
 - (2) On days when tribal standards are exceeded (downstream of border in tribal waters), Albeni is contributing heat to the river.
 - Therefore, Albeni should be assigned a TMDL allocation

Spatial Aggregation: Volume Averaging

Sum of (cell temp x cell volume)/(total volume) = volume-weighted average temperature

24.0
23.8
23.5
23.1
22.9
22.5
22.1
21.7
21.5

x

x

x

x

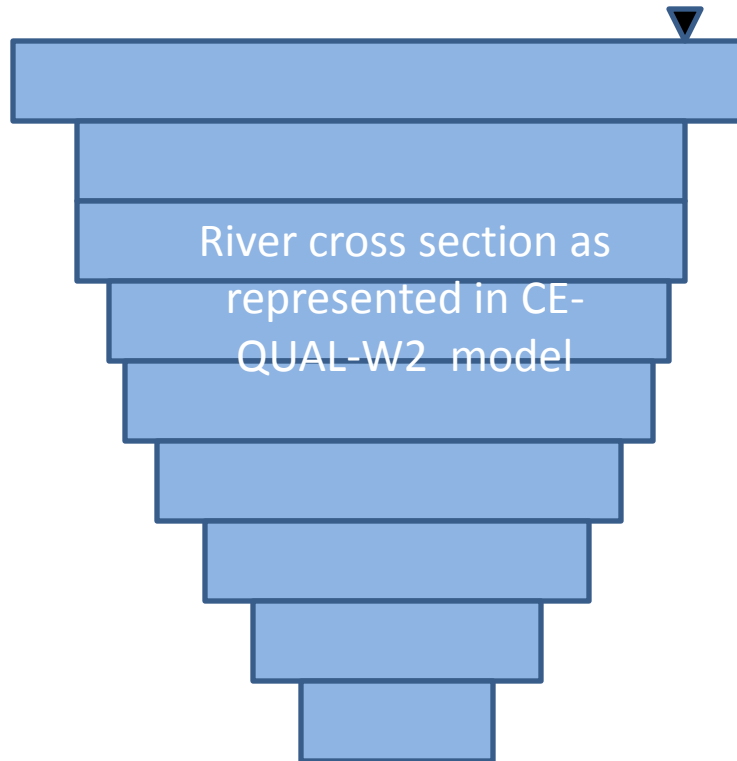
x

x

x

x

x



- Surface cell has greater volume than bottom, represents more habitat
- Volume-averaging used to get a single value that best represents water column as a whole
- Changes magnitude of estimated impairment

Why Use CFA and Reject Volume Weighted Averaging?

- Ecology adopted CFA (time-aggregation) but not Volume Weighted Averaging (spatial aggregation).
- CFA was chosen by Ecology to reduce model uncertainty and time lag effects without masking the dams' impacts
- Volume weighted averaging would have reduced allocations
- It is good science to examine and select model-data processing methods that account for model uncertainty, water quality standards metrics, allocation challenges, and other technical and policy considerations.

Conservative Decisions Made by Ecology

- Use of maximum cell temperature
- No volume weighted averaging
- Use of maximum difference from the CFA rather than averaging the differences
- For allocations, use of data from the warmer/ lower water year (2004) rather than typical year (2005)
- Stringent interpretation of winter season WQS for Pend Oreille River

Time permitting...we can include more detail from Helen's excursion analysis below

